07

II

E7.6-10394
CR-148181

Submitted by: Alaska Cooperative Wildlife Research Unit
University of Alaska
Fairbanks, Alaska

Contract No.: NAS5-20915

Investigation No. 22280

Title: Use of LANDSAT Imagery for wildlife habitat mapping in northeast and eastcentral Alaska

Type II Progress Report No. 4, May 6, 1976

A. Problems: None

B. Accomplishments: We accompanied Alaska Department of Fish and Game biologists on reconnaissance flights to the Tanana Flats. The purpose of these flights was to evaluate the 1:63,360 scale color coded map products of the Blair Lakes area. Overall, results were quite satisfactory but there was a problem with the classification of a recent burn (1972). At the time of the image (1408-20435 4 Sep 73), this area was very dark and the ground was covered with a tangle of charred, fallen trees. Most of this area was misclassified as either shallow water or bare ground.

We assume that, in most years, recent burns are relatively rare features which may be missed in the 2% random sample routine used for clustering. This seems to be the most reasonable explanation for the misclassification. It is not, however, a serious problem because the burn is visually evident on the image and correction of the map products can be readily accomplished manually. Nevertheless, in future analyses, it seems advisable to augment random sampling with directed sampling of spatially rare feature types which are significant to the analysis.

Full resolution (1:18,540) line printer maps of the six scenes recently analysed (1407-20374, 1408-20430, 1422-2-2-3, 1734-20471, 1771-20513, and 1771-20515) have been preprocessed for field use. This consists of:

Assembly (mosaic) of the printouts
Geographical orientation
Selection of cluster sites for ground truth
Plotting selected sites on 1:63,360 USGS map quads
Plotting boundaries of 1:63,360 quads on flight charts.
Plotting reconanissance flight routes on flight charts

Approximately 800 sites have been selected for overflight and aerial photography. Of these, about 120 will be visited on the ground to obtain more detailed data on vegetation.

22280

The first reconnaissance flight is cheduled for May 7th and several flights per week will follow until mid-July. These aircraft data will be used in selection of sites for ground visits. On the ground data collection is scheduled to begin in mid-July and should continue until early September.

C. Significant Results: There is strong indication that spatially rare feature classes may be missed in clustering classifications based on 2% random sampling. Therefore, it seems advisable to augment random sampling for cluster analysis with directed sampling of any spatially rare features which are relevant to the analysis.

D. Publications: None

E. Recommendations: None

F. Funds Expended:

Submitted by:

Alaska Cooperative Wildlife Research Unit
University of Alaska
Fairbanks, Alaska

Contract No.: NAS5-20915

Investigation No. 22280

Title: Use of LANDSAT imagery for wildlife habitat mapping in northeast and eastcentral Alaska

Type II Progress Report No. 3, March 8, 1976

A. Problems: None

B. Accomplishments: Portions of scenes 1734-20471, 1408-20435, 1408-20430, 1407-20374, 1771-20513, 1771-20515, and 1422-20203 within game management Unit 20 were analyzed. The same techniques previously used for analysis of scenes 1029-20383 and 1408-20435, namely clustering followed by maximum likelihood classification, were utilized. Full resolution LP maps (approximately 1:18,500 scale) were produced and will be used for summer field work. Total processing to date encompasses a composite total of about 4.3 entire scenes. This completes classification processing for this project.

The vegetation types emerging from the analysis of scenes 1029-20383 and 1408-20435 (see Tables 1 and 2; Appendices I and II; Report No. 2) were evaluated as winter and summer range for moose. Class combination reduced habitat categories to nine (Tables 1 and 2). Three high interest areas were selected where Department of Fish and Game biologists have recently or are currently involved with intensive moose range investigations. These areas are the Japan hills, the Blair Lakes - Clear Creek Butte region of the Tanana Flats, and the area south of the Alaska Highway between the Johnson and Little Gerstle Rivers.

Color maps products (1:63,360 scale) of these areas were produced. Each of the habitat categories were portrayed a different color and separate maps were prepared for summer and winter ranges. Selected geographic features such as contours, streams, and major trails were superimposed on the color products for geographical orientation. These products will be used and extensively evaluated by Alaska Department of Fish and Game biologists. The scale selected will permit direct comparison with habitat maps of these areas previously prepared from aerial photography. Production of these map products at this time will provide Alaska Department of Fish and Game biologists one more field season to gain experience with this type of product, evaluate them critically, and re-examine their own habitat interpretations. Thus, by next Fall, they will have a stronger experience basis for thematic interpretations and at that time, final map products for the entire Game Management Unit will be produced.

Concurrently, Alaska Cooperative Wildlife Research Unit field crews will obtain ground and aircraft reconnaissance data for definition of categorical analyses recently completed on six additional scenes.

Final thematic interpretations, preparation of final map products, and the final report are schedule for completion next Fall. The project should be completed according to schedule in early 1977.

C. Significant Results: Winter and summer moose range maps of three selected areas have been produced (1:63,360 scale). The analytic approach utilized is very similar to that described by Fleming, Berkebile and Hotter (1975) as "modified clustering". Preliminary indications are this method is not only more accurate but considerably less expensive than "supervised" classification techniques.

D. Publications: None

E. Recommendations: None

F. Funds Expended: $31,000

G. Data Use:

H. Aircraft Data: None

Literature Cited:

Fleming, M.D., J.S. Berkebile, and R. M. Hoffer. 1975. Computer-aided analysis of LANDSAT -1 MSS data: A comparison of three approaches, including a "modified clustering" approach. LARS Information Note 072475, Purdue Univ. 7pp.

Table 1

Cluster classes for scene 1029-20383

Cluster Identifier	Winter	Summer	Brief Descriptor	Color
1	2	2	Birch-white spruce forest (birch dominant)	(8) Lt. green
2	4	4	Black spruce heath	(18) Brown
3	8A	8A	Light colored mud and rock	(2) White
4	9	9	Agricultural fields	(5) Gray
5	1 (7)	2	Early successional fire recovery; birch willow	(8) Lt. green (7) Red
6	2	2	Mature aspen forest	(8) Lt. green
7	7 (18)	7	Black spruce bog	(1) Black (18) Brown
8	2	2	Mature birch	(8) Lt. green
9	3	3	Upland white spruce/birch (spruce dominant)	(10) Dk. Green
A	4	4	Black spruce-birch heath	(18) Brown
B	3	3	Mature white spruce	(10) Dk. Green
C	6	6	Upland brush-alder	(25) Orange
D	7 (1)	1	Moist tundra	(7) Red (1)Black
E	7 (1)	1	Eriophorum tussock meadow	(7) Red (1)Black
F	2	2	Cottonwood	(8) Lt. Green
G	8A	8A	Mud and silt	(2) White
H	5	5	Alpine tundra	(3) Yellow
I	4 (18)	7	Black spruce-tamarack muskeg	(1) Black (18) Brown
J	8	8	Deep water	(11) Blue
K	9	9	Agricultural fields	(5) Gray
L	9	9	*	(5)
M	8	8	Silty water	(20) Tan
N	8	8	Shallow clear water	(12) Blue
O	8A	8A	Gravel	(2) White
P	9	9	* Granite outcrops	(5)
Q	8A	8A	Gravel	(2) White
R	9	9	*	(5)

* Denotes classes which are too infrequent for accurate definition

Table 2
Cluster classes for scene 1408-20435

Cluster Identifer	Winter	Summer	Brief Descriptor	Color ( )
1	4	4	Black spruce heath	(18)
2	3	3	Mixed spruce	(18)
3	2	2	Birch-spruce forest	(8)
4	4	4	Black spruce-birch heath	(18)
5	8	8	Deep water	(11)
6	2	2	Mature birch	(8)
7	9	9	Undefined	(5)
8	9	9	Undefined	(5)
9	8	8	Silty water	(20)
A	2	2	Aspen forest	(8)
B	9	9	Undefined	(5)
C	8	8	Vegetation-water interface; combine with P	(12)
D	9	9	Undefined; probably cloud	(5)
E	8A	8A	Unvegetated mine tailings	(2)
F	1 (7)	2	High brush willow	(8)
G	8A	8A	Very sparsely vegetated sand and gravel	(2)
H	8A	8A	Light colored rock	(2)
I	1 (7)	2	Vegetated mine tailings	(8)
J	8A	8A	Mud and silt	(2)
K	8A	8A	Moderately vegetated mine tailings	(2)
L	4	4	Closed canopy spruce-birch forest	(10)
M	2	2	Mixed deciduous forest	(8)
N	8A	8A	Sparsely vegetated mine tailings	(2)
O				(4)
P	8	8	Shallow water	(12)
Q	2	2	Mid-successional birch	(8)

(no Eriophorum tussock #7) (no # 1, 7, 5, 6)
(no alpine tundra on the list #5)
(no upland brush-alder #6)
(no agr. field #9)

Submitted by:

Alaska Cooperative Wildlife Research Unit
University of Alaska
Fairbanks, Alaska

Contract No. NAS5-20915

Investigation No. 22280

Title: Use of LANDSAT imagery for wildlife habitat mapping in northeast and east central Alaska

TYPE II Progress Report No. 2, November 1, 1975

A. Problems: The EROS Data Center reported that two scenes selected for analysis were not available in CCT format because of poor data quality in single bands. Data orders for alternate scenes were similarly rejected by EDC but eventually six scenes for which CCT data is available were eventually selected and ordered. Therefore, the problem of CCT non-availability has wasted time but is not critical for this project. It is becoming a serious problem in other investigations we are carrying out for the Sierra Foundation, the U.S. Fish and Wildlife Service and the U.S. National Park Service.

B. Accomplishments: Portions of scenes 1029-20383 and 1408-20435 comprising a composite total of about 1.3 scenes were analyzed using an iterative clustering routine and maximum likelihood classification. Ground truth definition of analytic classes was accomplished during the reporting period (Tables 1 and 2; Appendices 1 and 2). Some classes emerging in the analysis were equivalent on each scene (Table 3) but, because each of the scenes contained unique ecosystems, there were classes on each scene which had no corresponding class on the other scene. For example,

scene 1029-20383 contained extensive alpine areas in the Alaska Range whereas the analyzed portions of scene 1408-20435 contained no true alpine regions. Thus, several categories of alpine vegetation in 1029-20383 had no corresponding classes on scene 1408-20435.

Similarly, a number of categories which are different stages of revegetation of mine tailings appeared in the analysis of scene 1408-20435 but no such categories appeared in the analysis of scene 1029-20383.

All significant definable categories are being evaluated with regard to specific moose habitat value. These evaluations are being made by Dr. John Coady and other personnel of the Alaska Department of Fish and Game (ADF&G). Based on these results, color coded moose habitat maps will be prepared at 1:250,000 and 1:63,500 scale from the classified digital tape. These products complement other ADF&G research on interior Alaskan moose populations and will be useful in revision of the management plan for Game Management Unit 20.

Digital tape data for five scenes (1407-20374, 1408-20430, 1734-20471, 1771-20513 and 1771-20515) have been obtained and data for scene 1422-20203 is on order. These data will be analyzed during the next quarter. Selection of ground sampling areas and preparation of map overlays will be accomplished during the spring quarter. Ground truth sampling for class definitions is scheduled for next summer and habitat

calculations for these scenes will be made next fall. Color coded habitat maps will be produced late next year and the final report will be available by January 1977.

In summary, the project is progressing according to schedule, results achieved to date meet previous expectations and no problems impeding successful completion are anticipated.

C. Significant Results: Two scenes were analyzed by applying an iterative cluster analysis to a 2% random data sample and then using the resulting clusters as a training set basis for maximum likelihood classification. Twenty-six and twenty-seven categorical classes, respectively, resulted from this process. Some of these categories were undefinable because they were rare and did not occur in large enough spatial groupings for confident ground location and sampling. However, the majority of classes in each case were quite specific vegetation types (Table 1 and 2; Appendices I and II). Each of these types has specific value as moose habitat and color coded moose habitat maps can be prepared from the feature classified digital tapes.

The analytic process described has several major advantages for Alaskan applications of LANDSAT data. First, all consistently differentiable major classes emerge in the analysis. Significant information contained in the data is not "buried" by a narrowly goal-oriented thematic analysis. Therefore, the same analytic results may be applied to a variety of

themes such as timber, wildlife habitat and water resources. Second, no ground truth is required initially to carry out classified data processing and, following such processing, ground truth tasks are clearly defined. Third, clustering and classification may be carried out entirely on a general computer without interactive capability. Therefore, data processing is less expensive than methods requiring use of a specialized interactive system. Cost benefits in this regard may exceed a 4:1 ratio. The only disadvantages of the method evident thus far are that rare feature classes may be missed entirely in sampling or their limited appearance in the results may not permit adequate definition.

D. Publications:

LaPerriere, A. J. 1975. Alaskan resources, current development, traditional cultural values and the role of LANDSAT data in current and future land use management and planning. NASA Earth Resources Survey Symposium. June 8-12, 1975. Houston. (In press.)

E. Recommendations:

None

F. Funds Expended:

$26,000.00

G. Data Use:

Data Product	Value of Data Allowed	Value of Data Ordered	Value of Data Received
CCT	$ 2,600	$ 800	$ 400
LANDSAT	3,500	---	982

H. Aircraft Data:

None

Table 1: Cluster classes for scene 1029-20383

Cluster Identifier	Brief Descriptor*
1	Birch-white spruce forest (birch dominant)
2	Black spruce heath
3	Light colored mud and rock
4	Agricultural fields
5	Early successional fire recovery: birch-willow
6	Aspen forest
7	Black spruce bog
8	Mature birch
9	Upland white spruce/birch (spruce dominant)
A	Black spruce-birch heath
B	Mature white spruce
C	Upland brush-alder
D	Moist tundra
E	Eriophorum tussock meadow
F	Cottonwood
G	Mud and silt
H	Alpine tundra
I	Black spruce-tamarack muskeg
J	Deep water
K	Agricultural fields
L	**
M	Silty water
N	Shallow clear water
O	Gravel
P	**
Q	Gravel
R	**

*For more detailed description of each class see Appendix I.

**Denotes classes which are too infrequent for accurate definition. Their occurrence is sporadic, rare and groupings of pixcels large enough for accurate ground location are not present. Some of these may be ecotonal classes representing mixtures of two or more classes while others may be artifacts resulting from calibration synchrony error in the scanner system.

Table 2: Cluster classes for scene 1408-20435

Cluster Identifier	Brief Descriptor*
1	Black spruce heath
2	Mixed spruce
3	Birch-spruce forest
4	Black spruce-birch heath
5	Deep water
6	Mature birch
7	Undefined
8	Undefined
9	Silty water
A	Aspen forest
B	Undefined
C	Vegetation-water interface; combine with P
D	Undefined; probably cloud
E	Unvegetated mine tailings
F	High brush willow
G	Very sparsely vegetated sand and gravel
H	Light colored rock
I	Vegetated mine tailings
J	Mud and silt
K	Moderately vegetated mine tailings
L	Closed canopy spruce-birch forest
M	Mixed deciduous forest
N	Sparsely vegetated mine tailings
O	**
P	Shallow water
Q	Mid-successional birch

*For more detailed description of each class see Appendix II

**Denotes classes whose occurrence is too infrequent and sporadic for accurate definition.

Table 3: Category correspondence emerging from independent analyses of scenes 1029-20383 and 1408-20435.

Category 1029 Identifier	Category 1408 Identifier	Descriptor
2	1	Black spruce heath
B	2	Mature spruce
J	5	Deep water
N	P	Shallow water
M	9	Silty water
8	6	Mature birch
A	4	Black spruce-birch heath
6	A	Aspen forest
C		Upland brush
1	3	Birch-spruce forest
3	H	Light colored rock
G	J	Mud and silt
9	L	Spruce-birch forest

Appendix I: Description of cluster classes on scene 1029-20383

Class 1 — Upland birch-white spruce: Areas dominated by young paper birch (Betula papyrifera) but containing some white spruce (Picea glauca) on relatively well drained sites. The shrub story is fairly well developed and consists of alder (Alnus ssp.) and willow (Salix ssp.). The ground cover is dominated by blueberry (Vaccinium uligonosum) and low bush cranberry (Vaccinium vitis-idaea) but Cornus canadensis, Rhodendron lapponicum, Epilobium latifolium, Empetrum nigrum and moss also occur.

Class 2 — Black spruce heath: Pure stands of stunted growth form-black spruce (Picea mariana) 3 to 5 meters in height. There is almost no tall shrub story although Salix planifolia and Rosa acicularis are occasionally present. These areas are poorly drained and ground cover is dominated by spaghnum moss. Other vegetation such as Vaccinium uligonosum, Vaccinium vitis-idaea, Ledum decumbens, Rubus chamaemorus, Empetrum nigrum, Petasites hyperboreus, fungi, foliose lichen and fruticose lichen are commonly present but not abundant.

Class 3 — Light colored mud and rock.

Class 4 — Agricultural fields

Class 5 — Mid-successional burn recovery/birch-willow: Dense stands of relatively young paper birch (Betula papyrifera) mixed with tall willow (Salix ssp.). Most of the birch are saplings but birch which has reached tree size is fairly common. Many white spruce (Picea glauca) saplings are present but very few have achieved tree size. There is no medium height shrub story and the major components of the ground cover are litter, Equisetum and Linnaea borealis.

Class 6 — Aspen forest: Pure stands of mature aspen in a late successional state. No aspen regeneration is occurring and most all aspen saplings are dead or dying. White spruce are invading but very few have reached sapling size. The shrub story consists of low density Salix ssp. 2 to 6 meters in height and Rosa acicularis. Ground cover is dominated by leaf litter but patches of moss, lichen, Ledum ssp. and Vaccinium vitis-idaea are commonly present but not abundant.

Class 7 — Black spruce bog: Poorly drained sites with poor growth form black spruce (Picea mariana) and an occasional tamarack (Larix larcina). Tall shrubs include Salix ssp. and Alnus ssp. Ground cover is dominated by moss but a variety of other species are commonly present: Potentilla fruticosa, Spirea beauverdiana, Vaccinium uligonosum, Vaccinium vitis-idaea, Vaccinium oxycoccus, Rubus chamaemorus, Ledum groenlandicum, Arctostaphylos rubra,

Chamaedaphne calyculata and Equisetum ssp.

Class 8 — Mature birch forest: Areas of large paper birch with very limited reproduction. Saplings of any tree species were quite rare. A well developed shrub story of tall willow and alder exists along with a secondary shrub story consisting of high bush cranberry (Viburnam edule) and wild rose (Rosa acicularis). Litter dominates the ground cover but moss, grass, Equisetum, Epilobium, Mertensia, Linneae borealis and Cornus canadensis are commonly present.

Class 9 — Upland white spruce-birch (spruce dominant): Mature white spruce-paper birch forest on upland sites. The shrub layer consists of Alnus, Rosa, Viburnum and Ribes. Ground cover is dominated by litter, grass, moss and Equisetum.

Class A — Black spruce-birch heath: Black spruce (Picea mariana) in variable growth form ranging from poor to moderate. These areas are, as a whole, poorly drained but paper birch occurs mixed with moderate growth black spruce on slight rises which have better drainage. A sparse understory of willow and alder exists and the ground cover is primarily moss and ericaceous heath. Tamarack (Larix larcina) also occurs sparsely mixed with black spruce.

Class B — Mature white spruce: Mature climax forest consisting almost

exclusively of very large white spruce. A few large paper birch and paper birch saplings are mixed in the forest but, in general, there is very little tree reproduction. The canopy is almost completely closed but the ground is relatively open and easily traveled on foot. Rosa and Viburnum occurs in low density and ground cover is dominated by moss.

Class C — Upland brush-alder: Moist tundra dotted with clumps of Alnus. Ground cover is dominated by moss, Carex, Petasites, Polygonum, Vaccinium uligonosum, Vaccinium vitis-idaea, Ledum decumbens and Betula nana.

Class D — Moist tundra: Relatively homogenous low growth moist heath tundra. Few plants on these areas exceed .3 m in height. Salix shrubs may be present but sparsely distributed and inconspicuous. Ground cover consists of moss, Betula nana, Vaccinium vitis-idaea, Vaccinium uligonosum, Ledum decumbens, Carex ssp., Empetrum nigrum, Arctostaphylos alpina, Polygonum bistorta, Rubus chamaemorus and Pedicularis ssp. Some Eriophorum vaginatum tussocks occur near small pools and in wetter depressions but are not abundant.

Class E — Eriophorum tussock meadow: Poorly drained areas dominated by Eriophorum tussocks with moss and sometimes standing water between the tussocks. Vaccinium uligonosum, Vaccinium vitis-idaea and Ledum are commonly present in the ground cover. Betula glandulosa

and several Salix ssp. especially Salix planifolia form a moderate to low density shrub story. Trees may be present at very low density and poor growth form or entirely absent. If trees are present, they usually are isolated spruce or tamarack in stunted growth form.

Class F — Cottonwood: Mature stands of large balsam poplar (Populus balsamifera). The shrub story consists of low density tall willow and lower shrubs such as Rosa acicularis and Viburnum edule. Litter dominates the ground cover but grass, Shepherdia canadensis, Linnaea borealis, moss, fungi, Mertensia, Aconitum and Equisetum are commonly present.

Class G — Mud and silt.

Class H — Alpine tundra: Ground cover is dominated by bare rock and Dryas octapetala. Other alpine plants which may be commonly present include Oxytropis nigriscens, Sythrisis borealis, Castilleja caudata, Artemesia artica, Arnica, Minuartia, Potentilla uniflora, Polygonum bistorta, Anemone narcissiflora, Silene acaulis, Carex ssp., grass, several species of prostate willow and others.

Class I — Black spruce-tamarack muskeg: These areas are similar to other black spruce classes (2, 7 and A) but contain a higher proportion of tamarack than any other black spruce class. Tree dbh is normally

small but density is relatively high. The shrub story is relatively low density and consists of Rosa and Salix. Ground cover is dominated by spaghnum moss but Equisetum, Vaccinium uligonosum, V. oxycoccus, V. vitis-idaea, Ledum ssp., Carex ssp., Rubus chamaemorus, Empetrum nigrum, Petasites ssp., Chamaedaphne calyculata and Arctostaphylos rubra may be commonly present.

Class J -- Deep water.

Class K -- Agricultural fields.

Class L -- Undefined.

Class M -- Silty water.

Class N -- Shallow clear water.

Class O -- Gravel.

Class P -- Undefined.

Class Q -- Gravel.

Class R -- Undefined.

Appendix II: Definition of cluster classes on scene 1408-20435

Class 1 — Black spruce heath: Relatively dense black spruce (Picea mariana) in poor growth form. Tall shrubs are primarily sparsely distributed Salix and the ground cover is dominated by moss and litter. Foliose lichen and ericaceous heath-complex species are commonly present in the ground cover.

Class 2 — Mixed spruce forest: Mostly closed canopy forest consisting of white (Picea glauca) and black (P. mariana) spruce in good growth form. Deciduous trees are quite rare in these areas and the shrub story consists of Salix ssp., Rosa and some Alnus. Ground cover varies with the extent of canopy closure and is ericaceous heath in more open locations but dominated by litter in more shaded areas.

Class 3 — Birch-spruce forest: Mixed forest dominated by paper birch (Betula papyrifera) mixed with Picea glauca and/or P. mariana. The tall shrub story is dominated by Alnus and/or Salix but Viburnum and Rosa are usually also present. Ground cover is dominated by moss and litter but grass, fungi, Cornus canadensis, Equisetum, Vaccinium uligonosum, Vaccinium vitis-idaea, Spirea beauverdiana, Linnaea borealis and Ledum ssp. are commonly present.

Class 4 — Black spruce-birch heath: Poor growth form black spruce mixed with a small amount of paper birch. The shrub story is very low density

consisting of occasional Alnus ssp. or Salix ssp. and ground cover consists of ericaceous heath complex species.

Class 5 — Deep water.

Class 6 — Mature birch: Closed canopy paper birch forest with large mature trees and very few saplings present. A well developed alder shrub story exists and ground cover is dominated by litter and Equisetum ssp.

Class 7 — Undefined*.

Class 8 -- Undefined*.

*Note: These classes are rare being represented by only 13 and 10 pixels respectively but I believe they are real. Both are very high reflecting in the red band; they are closely related to one another. Class 8 has small cluster distances to "bare rock" and water classes such as C, G, J and N. Both are probably foliage color against different ground cover backgrounds.

Class 9 — Silty water.

Class A — Aspen forest: Forested areas dominated by Populus tremuloides mixed with occasional Populus balsamifera and/or Betula papyrifera.

Tall shrub cover consists primarily of Rosa acicularis, Viburnum edule and some Salix ssp. Ground cover is dominated by litter but Equisetum ssp., Arctostaphylos uva-ursi and Mertensia ssp. may be locally abundant. Linnae borealis, Vaccinium uligonosum, Vaccinium vitis-idaea, Ledum ssp. and others may be commonly present.

Class B — Undefined (Note: High reflecting in red and relatively closely related to classes 7, 8, A (Aspen), (Upland brush) and K (moderately vegetated mine tailings). Probably bright foliage brush against unvegetated light colored ground, e.g., bright foliage brush on a largely unvegetated gravel bar.

Class C -- Vegetation-water interface; combine with P.

Class D — Undefined; probably cloud.

Class E — Unvegetated mine tailings.

Class F — High brush willow: Early successional fire recovery with many standing dead trees but only a few sparsely distributed living trees. Shrub story consists of moderate to high density Salix ssp. 1 to 2 meters in height. Ground cover is dominated by litter, ericaceous plants and Equisetum ssp. Approximately 1/3 browse (moose) on the 6 to 8 species of Salix present.

Class G — Very sparsely vegetated sand and gravel.

Class H — Gravel; aircraft strips, roads, etc.

Class I — Vegetated mine tailings: Mixed deciduous trees consisting of paper birch, aspen and cottonwood with an understory of willow and alder. Litter dominates the ground cover but as much as 40% bare rock may be present.

Class J — Mud and silt: Sparsely vegetated mud and silt on river islands. Small patches of gravel, pioneer willows and isolated clumps of grass, sedges and Juncus may be present.

Class K — Moderately vegetated mine tailings: Mixed deciduous trees (paper birch, aspen and cottonwood) at low density. A low density shrub story of willow is present and ground cover is dominated by bare rock (up to 90%).

Class L — Closed canopy spruce-birch forest: Relatively dense mixed spruce in moderate growth form occurring with paper birch. Black spruce dominates. The shrub story is relatively low density and consists principally of Alnus ssp. and Rosa acicularis. Moss dominates the ground cover but Equisetum ssp. and ericaceous plants commonly occur.

Class M — Mixed deciduous forest: Mature forest consisting of aspen, paper

birch and some balsam poplar. The shrub story consists of tall willows and a lower story of high bush cranberry and wild rose. Litter dominates the ground cover but Cornus canadensis and Epilobium angustifolium are common. Mertensia paniculata, Linnaea borealis, Galium boreale, Pyrola ssp. and Lycopodium may be locally abundant depending upon the dominant tree species.

Class N -- Sparsely vegetated mine tailings: Mixed deciduous trees (birch, aspen and balsam poplar) invading in favorable locations. Willows and alder are also invading but the ground cover is almost 100% bare rock. The only other vegetation commonly occurring in ground cover is Epilobium angustifolium and lichens.

Class O -- Undefined.

Class P -- Shallow water.

Class Q -- Mid-successional birch: Closed canopy forest dominated by paper birch trees and numerous saplings. Small clumps of aspen may be occasionally present. The shrub layer is moderate density and consists of Rosa, Viburnum and Ribes. Ground cover is dominated by litter and Equisetum.

Contract No. NAS5-20915
Investigation No. 22280
Title: Use of LANDSAT imagery for wildlife habitat mapping in northeast and east central Alska
TYPE II: Progress Report No.1

A. Problems: Failure of NASA and EROS Data Center, U.S.G.S., to reach agreement in a timely manner on provisions for supply of LANDSAT data to the contractor impeded initial progress. These problems now seem to be resolved.

B. Accomplishments: A data file search resulted in selection of five LANDSAT scenes for analysis. These are: 1029-20383, 1408-20435, 1734-20471, 1768-20432, and 1422-20203. Of these, digital tapes were on hand at the University of Alaska for scenes 1029-20383 and 1408-20435. Digital tape format data for the remaining three scenes were ordered from EROS Data Center in March.

Experimental de gn/data processing specifications were formulated during January and six facilities were invited to submit bids for data processing. Two of these, Bendix Aerospace Systems Division of Ann Arbor, Michigan and ESL, Inc. of Sunnyvale, California, responded with bids. The low bid was submitted by ESL, Inc. and that firm was awarded the data processing contract

Methods -- The experimental design utilizes a four phase approach namely, clustering, classification, definition, and thematic interpretation.

The clustering phase involves 2% random sampling of the LANDSAT data to be analysed. These data are processed with an iterative spatial and spectral cluster routine using three standard deviation criteria.

The classification phase involves use of the resulting clusters as training sets for data classification using a maximum likelihood algorithm. Interim data products include Dicomedcompatible feature classified digital tapes, 1:63,360 scale feature classified, geometrically corrected, line printer maps, and 1:18,500 scale feature

classified, geometrically corrected, line printer maps. The line printer maps are for use in the definition phase and the digital tape products are for use in generation of final products.

The definition phase involves ground truth definition of the classification results. Homogenous areas of specific cluster classes are identified on the 1:18,500 line printer outputs. Ten randomly selected points are plotted within these areas and quantitative data describing the vegetation is obtained at those points. To facilitate geographic location, positive transparencies of USGS maps have been prepared to printout scale. These transparencies are overlaid and registered to the line printer output. The 1:18,500 scale output is utilized in obtaining ground data while the 1:63,360 output is utilized for collection of aerial reconniassance data.

Following cluster-class definition/thematic interpretation will be formulated. Each class will be evaluated in terms of habitat value for moose. Based upon these evaluations, a color coded habitat map will be produced from the classified digital tapes. The digital tapes, however, will continue to remain available for subsequent revisions to the analysis or alternate thematic analyses.

Results (not"significant" yet) -- Portions of scenes 1029-20383 and 1408-20435 were processed at ESL in Sunnyvale during April and May. Total processing comprises a composite total equivalent to about 1.3 scenes. The iterative clustering technique produced 26 classes for scene 1408-20435 and 27 classes for scene 1029-20383.

During the latter part of May, ground truth areas for class definition were selected and transparent map overlays were prepared. The field effort was initiated in early June and will continue until early September. To date, activities have been confined to ground data sampling but emphasis will shift to aerial reconnaissance and photography during the seasonal period of the LANDSAT images being utilized (late August - early September).

Sixteen of the 26 classes for scene 1408-20435 have been defined and these correspond to discrete will defined feature types. With the exception of three water classes, the remaining classes defined thus far all have significantly different value in terms of moose habitat. For example, one class is mixed spruce, another is mature birch with and alder understory, still another is mid-successional birch, etc.

Similarly, 5 of 27 classes have been defined for scene 1029-20382. These also correspond to discrete,well-defined feature types.

Proposed Activity -- In late August - early September, thematic evaluations will be finalized and final products prepared as soon as possible. These may be available for use by the management agency within the next year.

After the above has been accomplished, a data file search will be initiated to identify suitable 1975 LANDSAT imagery covering the southwest portion of Game Management Unit 20. This area includes Mount McKinley National Park. One scene has been identified and tentatively selected for analysis. However, it is not a very desirable choice because extensive scattered cumulus clouds are present. If more suitable data is obtained in 1975, it will be analysed instead.

During late Fall or early Winter, scenes 1734-20471, 1768-20342, and 1422-20203 will be processed along with the scene finally selected for the southwestern region.

C. None

D. None

E. None

Prepared by -- Arthur J. LaPerriere
Research Associate

Approved by -- Peter C. Lent
Assistant Leader
Alaska Cooperative Wildlife Research Unit
University of Alaska
Fairbanks, Alaska
August 1, 1975